

**An Evaluation of Life and Disability Insurance, Workers'
Compensation Insurance and Regulations of the
Annuity Market in the Mexican Pension System for
Private Sector Employees.**

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An Evaluation of Life and Disability Insurance, Workers' Compensation Insurance and Regulations of the Annuity Market in the Mexican Pension System for Private Sector Employees.

The current pension system for private sector employees started operations the first of July of 1997, according to the Social Security Law (SSL) enacted in December of 1995.

The pension system is multipillar. The first pillar is a defined benefit scheme through a minimum pension guarantee by the Federal Government. The second pillar is a defined contribution plan. The third pillar is a voluntary savings scheme.

During the accumulation stage workers' accounts are privately managed by specialized pension funds with individual choice.

For the decumulation stage, if a worker dies or becomes disable, she or her beneficiaries must buy an annuity from a specialized insurer carrier. If a worker retires at old age (65 years or older) or due to severance at old age (at least 60 years old) she can choose between a programed withdrawal offered by a pension fund and an annuity offered by an insurance firm.

Life and disability insurance and workers' compensation insurance are provided exclusively by the "Instituto Mexicano del Seguro Social" (IMSS), a public institution founded in 1943 to manage social security programs for private sector workers.

The analysis of the mexican pension system for workers affiliated at IMSS has been concentrated on the accumulation stage. Too little attention has been given to the desaccumulation stage, eventhough most of the risks are borne by the insurance firms created to offer annuities to workers.

The purpose of this note is to provide a general evaluation of the desaccumulation stage of IMSS pension system. The design of life and disability insurance, workers' compensation insurance and of the regulations prevailing in the annuity market is analyzed.

The main conclusion is that the design is not efficient and that it must be revised in order to guarantee benefits to workers at a lower cost to all participants: workers, employers and the Government.

It is shown that premiums for the lines of insurance provided by IMSS do not consider expected payments as a function of the prevailing prices in the annuity market and the accumulated balance in the individual accounts.

Life and disability premium seems to be insufficient and higher than the premiums observed in other countries with similar pension schemes. On the other hand, the premium for workers' compensation insurance seems to be too high.

With respect to the regulation of the annuity market, general comments are provided on the adequacy of the required technical reserves, on excess capital requirements and on the current investment guidelines.

It is argued that the Special Mathematical Reserve should replace the Prevision Reserve and that the current Prevision Reserve and the Reserve for Changes in Assets' Value should disappear.

Investment guidelines impose quantitative restrictions presumably to mitigate risk exposure. However a carrier's risk exposure depends on compromised liabilities and investment strategies and therefore it would be better to change investment regulations towards the prudent investor rule and to set capital requirements according to possible cash flows mismatch between assets and liabilities.

The note is organized as follows: in the first section the pension system is described. In the second the regulations of the annuity market are presented. The third and fourth presents, respectively, an evaluation of the insurance provided by IMSS and of the regulations faced by insurance carriers. The last presents the main conclusions.

1. Description of the Pension System¹

Every worker affiliated to IMSS must have an account with three subaccounts denominated as: retirement due to severance at old age or old age (which will be called subsequently as retirement account), housing and voluntary savings. The level of contributions for the first two subaccounts are shown in table 1.1.

Table 1.1
Contributions and percentage of wage

	Workers	Employer	Government	Total
Retirement	1.125%	5.150%	0.225% + FC	6.500%+FC
Housing	-----	5.000%	-----	5.000%+FC
Total	1.125%	10.150%	0.225% + FC	11.500%+FC

FC: Fixed Quota. FC = 5.5% of minimum wage in 1997 indexed thereafter to CPI

Source: Mexico Social Security Law

The Government contributions to the retirement account are equal to 0.225% of the wage and a contribution defined in pesos that is deposited to all workers accounts. This contribution was equivalent to 5.5% of a minimum wage in Mexico City (Distrito Federal) in July of 1997 and thereafter that amount in pesos has increased every three months according to the observed variations in the Consumer Price Index (CPI).

During the accumulation stage, IMSS provides workers the following services: collection of contributions, life and disability insurance and workers' compensation insurance.

The record keeping and the pension funds investment management services for the retirement and voluntary savings accounts are provided by specialized firms named "Administradoras de Fondos para el Retiro" (Afores). Workers are entitled to choose among the different Afores and are allowed to change provider once per year.

¹ For a more detailed description of the system see Solís Soberón (2000).

The funds deposited in the housing account are channelled to a public mortgage institution denominated “Instituto del Fondo Nacional para la Vivienda de los Trabajadores” (Infonavit).

For the decumulation stage, if a worker dies or becomes disabled, she or her beneficiaries must buy an annuity from one of the specialized insurance carriers, and are not allowed to change provider thereafter.

If a worker retires due to old age or severance at old age, is allowed to choose between a programmed withdrawal service provided by an Afore or to buy an annuity from an insurance company. If a worker chooses a program withdrawal, will have the option to buy at any time an annuity with the remaining funds.

Afores are authorized and regulated by the “Comision Nacional del Sistema de Ahorro para el Retiro” (Consar). Insurance firms are authorized by the Secretaria de Hacienda y Credito Publico (SHCP), and are regulated by SHCP and by the “Comision Nacional de Seguros y Fianzas” (CNSF).

1.1 Withdrawals from the Individual Accounts

There are two types of withdrawals: partial and total. Partial withdrawals are allowed during the accumulation stage and total withdrawal takes place when a worker leaves the labor market due to disability, death, retirement at old age, severance at old age, or by anticipated retirement.

Partial Withdrawals

Partial withdrawals from the retirement account are possible if a worker gets married or is unemployed. The aid for marriage is equal to 30 days of a minimum wage in Mexico City. This aid can be used only once in a life time and the worker must have contributed to the system at least 150 weeks.

If a worker is unemployed, she can withdraw an amount equal to 65 days of her average wage in the last 250 weeks or 10 percent of the outstanding balance whichever is less. To be eligible, a worker must have been unemployed for at

least 46 days and will only be allowed to withdraw for this purpose once every five years.

Withdrawals from the voluntary savings account can be done on a regular basis every six months after the last withdrawal.

With respect to the housing account, if a worker obtains a mortgage from Infonavit the outstanding balance is transferred to this institution as a down payment and thereafter the flows are also channeled to Infonavit until the mortgage is paid completely.

Total Withdrawals

Retirement age is equal to 65 for old age and to 60 due to severance at old age. In either case, if the worker contributed to the pension system 1,250 weeks or more, she can choose between an annuity or a programmed withdrawal.

There is a Minimum Pension Guarantee (MPG) equal to a minimum wage as of the first of July of 1997 and thereafter has been adjusted every year according to observed variations in the CPI. Currently it is close to 130 dollars per month.

It should be mentioned that for those workers that contributed to the system before the 1 of July of 1997, there is an additional put option at retirement. They will be allowed to choose between the benefits of the previous law or the current law, whichever is best for them. If they choose to retire according to the benefits of the previous law, they must give the accumulated balance in the retirement and housing accounts to the Government.

If the accumulated balance at retirement is less than what is needed to obtain an annuity greater than or equal to the MPG, the worker is required to have a programmed withdrawal and when resources are exhausted the Government is responsible of paying the MPG to the worker.

If a worker reaches retirement age and did not contribute to the system 1,250 weeks, is allowed to keep contributing to reach the required number of weeks or to make a lump sum withdrawal of the outstanding balance.

It is possible for a worker to retire before the retirement age if the accumulated balance in the individual account is greater than or equal to the amount necessary to buy an annuity equal to 1.3 times the MPG. In this situation a worker may withdraw the remaining surplus.

It is also possible for a worker to retire according to the conditions established in an occupational pension scheme sponsored by an employer. However, the plan must be registered at Consar to certify that it is fully funded. If eligible the worker may withdraw the accumulated funds, by a programmed withdrawal, buying an annuity or through a lump sum payment.

If a worker becomes disabled or dies, the worker or her beneficiaries are entitled to a pension. The pension is defined in the SSL. There are two types of insurance provided by IMSS to protect workers against these risks: life and disability insurance and workers' compensation insurance.

In case of disability or death, IMSS pays workers or beneficiaries an amount equal to the difference between the amount required to buy an annuity and the accumulated balance in the retirement and housing accounts. The amount required to buy the annuity is referred to in the SSL as "Monto Constitutivo" (MC). The SSL establishes that all pensions must be indexed to the CPI.

1.2 Life and Disability Insurance

The payroll tax is equal to 2.5% of the wage. Employers pay 70% of the tax, workers 25% and the Federal Government 5%.

To be eligible, a worker must contribute to the plan at least 150 weeks. A worker is considered disabled if she cannot with another job earn a wage greater than or

equal to 50% of her last wage due to a an accident or sickness not related to her job.

The disability pension is equal to 35% of the average wage for the last 500 weeks. Additionally she is entitled to receive some family related benefits and an annual payment equivalent to the monthly pension which is given at the end of each year.

Death benefits are shown in table 1.2. It should be mentioned that benefits to beneficiaries cannot exceed those that would have been received by a disable worker, and if necessary are reduced proportionally among all individuals eligible to receive a pension.

Table 1.2
Death Benefits

Beneficiary	Benefit	Term
Wife or Concubine	90 % of the disability pension	Will be paid for life, unless the widow marries again or becomes a concubine. There is a settlement payment equal to three times the annual pension.
Husband or Concubine	90 % of the disability pension	Term and settlement conditions are the same as before, but to be eligible he must show economic dependency on the insured worker.
Children	Orphanhood of one parent: 20% of the disability pension.	Until 16 years old, or until 25 years if they study within the national education system. There is a final payment equal to three months of the pension.
Parents	Both parents: 30% of the disability pension. 20% of the disability pension	For eligibility, there must be no widower, orphans or concubine with right to a pension.

Source: Mexico Social security Law

1.3 Workers' Compensation Insurance

This insurance protects workers from professional risks that may cause partial or total disability or death. The degree of disability is established in the Federal labor Law.

The premium is paid exclusively by employers and is established as a percentage of the wage. It is determined taking into consideration the working conditions of the industry to which the firm belongs and its past claims experience. If a firm has no past claims experience the premium is set according to the following table:

Table 1.3
 Premiums for Workers' Compensation Insurance
 For Firms with No Past Claims Experience

CLASS	Premiums (% over wage)
Class I: Life Ordinary Risk	0.54355
Class II: Low Risk	1.13065
Class III: Medium Risk	2.59840
Class IV: High Risk	4.65325
Class V: Maximum Risk	7.58875

Source: Mexico Social Security Law

For those firms with past claims experience, the formula used is the following:

$$[(S/365)+V*(I+D)]*(F/N)+M$$

Where:

V = 28 years, which is the average active lifetime of a worker.

F = 2.9, which is a premium factor.

N = average number of workers exposed to risk.

S = number of days subsidized for temporal disability.

I = percentage sum of the permanent, partial and total disability claims divided by 100.

D = number of deaths.

M = 0.0025, which is called the minimum risk premium.

An injured or sick worker is entitled to receive the following fringe benefits: medical assistance, surgery, medicines, hospital services, ortopedial devices and

rehabilitation. Cash benefits are funeral expenses and temporal or definite pensions.

The pension for total disability is equal to 70% of the last wage in case of injury or to the average of the last 52 weeks in case of sickness. Besides there is an annual bonus equal to 15 days of the monthly pension.

In case of partial disability, the benefit varies as follows: if disability is greater than 50% according to the Federal Labor Law it is the same as for total disability. If it is between 25% and 50%, the pension is set according to a table established in the forementioned law, taking into consideration the pension that would have been obtained in case of total disability. If disability is less than 25%, the worker receives a lump sum payment equal to 5 times an annual pension.

If a worker dies, IMSS pays beneficiaries 60 days of the minimum wage in Mexico City and beneficiaries may also be entitled to receive a pension.

2. Regulations in the Annuity Market

As mentioned before, workers can only buy annuities from specialized insurance firms authorized by SHCP and regulated by CNSF.

According to the law, the procedures to estimate the MC for the annuity market are responsibility of a Comittee called “Comité de Montos Constitutivos” (CMC). The CMC has eleven members: 3 from CNSF, 2 from SHCP, 2 from IMSS, 2 from ISSSTE and 2 from Consar.²

The CMC determines the actuarial tables and the interest rate necessary to calculate an MC. Currently the real interest rate determined by the CMC is equal to 3.5%, besides the CMC allows insurance firms to charge as much as 1% of the MC for underwriting expenses and an additional 2% load on the MC for deviations in the expected loss ratio.

² ISSSTE stands for “Instituto de Seguridad y Servicios Sociales de los Trabajadores del Estado, which is the public intitution responsible of social security for Federal Government employees.

Since the annuity market in Mexico before 1997 was practically nonexistent, the survivorship probabilities by age and sex groups were provided by the “Consejo Nacional de Poblacion” (Conapo), a government agency dedicated to demographic studies on Mexico's population. These probabilities were loaded by the CMC for unfavorable deviations from the expected loss ratio and to take care of the rising trend in workers' longevity.

Insurance firms compete on the basis of providing workers additional benefits such as higher pensions, life insurance and child support educational income, among others.

As mentioned before SHCP and CNSF regulate insurance firms. These firms are required to create the following technical reserves:

1. **Mathematical Reserve.** This reserve is determined to guarantee benefits. For annuities due to disability or death it is determined with the actuarial tables published by CNSF and a real interest rate equal to 3.5%.
2. **Current Risks Reserve for Additional Benefits.** It is set according to a technical note that must be registered at CNSF, taking into consideration the actuarial tables published by the Insurance Commission and the compromised real rate of return for additional benefits.
3. **Special Mathematical Reserve.** It is equal to 100% of what is called favorable loss surplus. Favorable loss surplus is defined as the minimum between the difference of the maximum expected loss and the observed loss and the difference of the maximum expected loss and the minimum expected loss. If the difference between the maximum expected loss and the observed loss is negative, the surplus is set equal to zero.

The maximum expected loss is defined as the summatory of the monthly increments in the mathematical reserve plus the risk premiums of the policies sold during the month, adjusted by a minimum rate of return. The minimum rate of return is equal to the reserve of the previous month plus one half the

risk premium of policies sold in the month minus one half the monthly payments times an adjustment factor equal to 1.035 times one plus observed inflation during the month. The minimum expected loss is equal to 95% of the maximum expected loss.

The way in which this reserve can be used has not been determined.

4. **Prevision Reserve.** This reserve is created for unfavorable deviations in the expected loss ratio. It must be equal to 2% of the mathematical reserve. In the absence of unfavorable losses, each year the insurance company may release the summatory of the monthly differences between the previous month reserve multiplied by the adjustment factor defined above plus 2% of the risk premium times the adjustment factor less 2% of the corresponding Mathematical Reserve. The released reserve must go to a special fund described below.
5. **Reserve for Changes on Assets' Value.** This reserve is used if the assets in which technical reserves are invested experienced a loss in market value. The reserve is constituted with 15% of the summatory of the monthly differences between the average real market rate of return observed in the month and the real interest rate of 3.5% times one half of the difference between risk premiums of sold policies and benefit payments within the month. The reserve cannot exceed 10% of all reserves, excluding this reserve and the Pending Obligations Reserve.
6. **Pending Obligations Reserve.** It must be equal to the pending obligations of the insurance firm.
7. **Special Fund.** A fund was created to accumulate excess funds to be used if the MCs established by IMSS were insufficient due to unforeseen changes in the number of beneficiaries and unforeseen losses due to actuarial assumptions. It may also be used if insurance firms due to prevailing conditions in financial markets are not capable to obtain an adequate real rate

of return for the technical reserves. The fund is constituted by the annual releases in the Prevision Reserve and the Reserve for Changes on Assets Value.

The investment guidelines for the thechnical reserves are based on quantitative restrictions. Particularly, the corresponding assets for each reserve must be invested in short term securities (maturity whithin one year) as shown in table 2.1:

Table 2.1
Liquidity Limits

Reserve	Minimum Percentage in Short Term Investments
Mathematical and Current Risks	8%
Special Mathematical Prevision	8%
Changes on Assets´ Value	8%
Pending Obligations	100%

Source: Mexico National Insurance and Guarantees Commission (CNSF)

Since all annuities are indexed to the CPI, the investment guidelines also require that all securities must guarantee a nonnegative real rate of return. Table 2.2 shows the permissible investment limits per type of security.

Table 2.2
Investment Guidelines

By Bond Type, Good, Credit or Other Asset.	% of Total Asset Value
I. Bonds issued by the Federal Government	100% Max.
II. Bonds issued by Banks and other Financial Intermediaries	60% Max.
III. Bonds issued by Banks and other Financial Intermediaries different from clauses I and II of this fraction.	30% Max.
IV. The following bonds, assets or credits, without going beyond the indicated limits: a) Operations with discount and rediscount b) Credits with bond or asset holding guarantee. c) Credits with mortgage guarantees d) Urban real property of regular products	30% Max. 5% Max. 5% Max. 5%Max. 25% Max.
By Issuer or indebted	
V. Bonds issued by the Federal Government .	100% Max.
VI. Bonds issued by Banks and other Financial Intermediaries	18% Max.
VII. Bonds different from clauses I and II of this section.	18% Max.
VIII. Group shares, institutions or societies whose economic activity sector –designated by Mexico’s National Bank and Bond Commission- constitutes common risks for the insurance institution or mutual insurance society.	10% Max.
IX. Shares, bonds, discount and rediscount operations, credits or loans in favor of entities constituting financial groups, institutions, societies or persons, that by their patrimonial or responsibility nexus for the institution or mutual insurance society, constitute common risks.	5% Max.
X. Shares, bonds, discount and rediscount operations, credits or loans in favor of entities constituting financial groups, institutions, societies or persons, that by their patrimonial or responsibility nexus between issuers, constitute common risks.	18% Max.

Source: Mexico’s National Insurance and Guarantees Commission (CNSF).

3. An Evaluation of Life and Disability Insurance and Workers' Compensation Insurance

To evaluate life and disability insurance, a simple model for pricing risks is presented. Let \bar{R}_t^i be the annuity that according to the law an eligible worker i must receive in period t . Then, the required MC_t^i given the maximum annuity price determined by the CMC, \bar{p}^i , is the following:

$$MC_t^i = \bar{p}^i \bar{R}_t^i; \quad (1)$$

$$\bar{p}^i = \frac{\sum_{j=1}^k \bar{v}^j \bar{q}_{t,j}^i}{1-l}; \quad (2)$$

$$\bar{v}^j = (1+\bar{r})^{-j}. \quad (3)$$

Where,

$\bar{q}_{t,j}^i$ = the joint survivorship probability of worker and beneficiaries for j periods determined by CMC.

\bar{r} = real interest rate determined by CMC.

k = maximum number of years that a worker is expected to live.

l = load determined by CMC for underwriting expenses and unexpected losses.

IMSS must pay to a worker an amount, SA_t^i , equal to the difference between (1) and the accumulated balance in the individual account, S_t^i :

$$SA_t^i = MC_t^i - S_t^i. \quad (4)$$

The level premium, a , is determined by equating the expected present value of future payments by IMSS with expected collection of payroll taxes:

$$a = \frac{E_t \sum_{t=1}^{\infty} \sum_{i=1}^{m_{t+t}} b^t SA_{t+t}^i}{E_t \sum_{t=1}^{\infty} \sum_{i=1}^{n_{t+t}} b^t w_{t+t}^i},$$

$$b = (1+r)^{-1}.$$
(5)

Where,

m_{t+t} = number of workers eligible to receive a benefit in period $t+t$.

n_{t+t} = number of workers that contribute to the pension scheme in period $t+t$.

w_{t+t}^i = worker's wage in period $t+t$.

r = discount rate.

E_t = conditional expectation given information set at t .

It follows from (5) that the premium depends directly on the value of the MCs and inversely with respect to expected returns on savings in the individual accounts. Because of this, the current design of life and disability insurance is inadequate since the premium was set arbitrarily in the SSL published in December of 1995, several months before the CMC was created.

To illustrate the use of (5) the following assumptions are used: (1) Conapo's estimates of labor force growth rate equal to 2.2% for the period 2000-2005, 2% for 2006-2010, 1.4% for 2011-2016 and 0% thereafter; (2) real wage growth rate equal to 1%; (3) actuarial assumptions based on IMSS past experience; and (4) six scenarios for real returns in the accounts and the real interest rate determined by CMC, shown in table 3.1.

Table 3.1
Scenarios

Scenarios	Retirement Yield%	Housing Yield%	Technical Rate %
A	3.5	0.0	3.5
B	5.0	0.0	3.5
C	5.0	5.0	3.5
D	3.5	0.0	4.5
E	5.0	0.0	4.5
F	5.0	5.0	4.5

The results for the different scenarios and two discount rates are shown in table 3.2. The premium is higher with the higher discount rate. As expected the premium is higher the lower the returns are in the accounts and the lower is the rate determined by CMC. In any event the premium is higher than the one stated in the SSL at 2.5% of the wage.

Table 3.2
Level Premium Scenarios

ρ	A	B	C	D	E	F
5.00%	3.15%	3.12%	3.08%	3.02%	2.99%	2.95%
3.50%	3.09%	3.06%	3.02%	2.96%	2.94%	2.90%

Source: Author calculations

If we compare the current premium with the premiums in other countries with similar pension schemes in Latin America, as shown in table 3.3, it is the highest.

Table 3.3
Equilibrium premiums

Countries	Equilibrium Premium
Mexico	2.50
Bolivia	2.00
Colombia	1.87
Peru	1.38
Argentina	0.91
Chile	0.64
Uruguay	0.57

Source: QUIESSER, Mónica. The second generation pension reform in Latin America

In our opinion the premium is insufficient and higher than in other countries because of the following reasons:

1. Disability is based on earnings and not on physical aptitudes as in workers' compensation insurance.
2. The time period to determine total disability is too short.
3. The real interest rate determined by CMC is too low.
4. The loads determined by CMC are too high.
5. The accumulated balance in the individual accounts in Mexico is lower than in other countries since there are no recognition bonds for transition workers between the old and the new pension scheme.
6. Lack of incentives to reduce the loss ratio since the life and disability insurance and workers' compensation insurance are solely provided by IMSS.

The design problems in workers' compensation insurance are discussed in Gonzalez (2000).

The formula that is used to determine the premium to be paid by a firm, comes from a static model that uses observed frequency times observed severity. In this model, frequency, f , is equal to the ratio of the number of claims, n , to the number of workers, N :

$$f = \frac{n}{N}. \quad (6)$$

Severity, V , is constructed from the number of days for which a worker is expected to be compensated, S , with respect to the number of natural days in a year which is equal to 365, the sum of the percentages of total and partial disabilities, I , the number of deaths, D , and the expected active life of a worker, V (equal to 28 years), as follows:

$$V = \frac{(S/365) + V(I + D)}{n} \quad (7)$$

The resulting risk premium, j , is equal to the following:

$$j = \frac{(S/365) + V(I + D)}{N} \quad (8)$$

The premium established by IMSS is equal to the risk premium (8) times a load factor F (equal to 2.9) plus a load M for administrative expenses equal to 0.0025. The resulting premium is:

$$j F + M \quad (9)$$

As pointed out by Gonzalez (2000) and as can be easily deduced from (9), the premium is arbitrarily loaded by 190%, and the model does not consider wage growth and the accumulated balance in the individual accounts. Besides, there is no charge in the model for the provision of fringe benefits as stated in the SSL.

The arbitrary loads and the exclusion of the accumulated balance in the accounts overestimates the equilibrium premium, and the exclusion of fringe benefits underestimates the premium. However, Gonzalez shows by analyzing income financial estimates of IMSS that in 1999 collected premiums were 90% higher than payments.

As must be clear, the design of life and disability insurance and of workers' compensation insurance must be thoroughly revised. Besides, in order to diminish the level premiums towards international standards, consideration must be given to the possibility of opening competition to the provision of the services by private insurance firms.

If life and disability premiums are reduced to the international standards, the accumulation in the individual accounts would be enhanced, pensions would be higher and the fiscal cost would be lower than what is currently expected.

If premiums in workers' compensation insurance are reduced, labor taxes would be lower. This could increase labor market formality and could mitigate evasion.

4. An Evaluation of the Regulation in the Annuity Market

It follows from (1) that the level of the MCs that must be paid by IMSS depends on the variables determined by the CMC: real interest rate, probabilities of survivorship, and the loads. Clearly, the lower the real interest rate and the higher the assumed probabilities and loads, the higher must be the MCs. The higher are the MCs, the higher will be the equilibrium premiums in life and disability insurance and workers' compensation insurance.

As mentioned before the real interest rate currently used is 3.5%, which is supposed to represent the CMC view on long-term real interest rates for México. However it may be too conservative and therefore annuities may be too expensive.

With respect to the probabilities determined by CMC, as mentioned before were suggested by Conapo to the comitte and were loaded by it. The load must have taken into consideration a probability distribution of survivorship, the random variable. Therefore it is not clear why and how the additional load of 2% of the MCs was established. It also seems to high and therefore for this reason annuities seem to be too expensive as well.³

It was also mentioned that a load equal to 1% of the MCs was put in place for underwriting expenses. It seems also high and is related to the market structure that prevails in the annuity market, which requires to finance sales agents of insurance companies. Some alternative ways to distribute directly the product to workers should be explored by the industry and perhaps also by CNSF.

³ It has been mentioned to us by market participants that the 2% load has an additional objective, which is to cover the risk that the number of beneficiaries may change over time, risk that cannot be measured at the time being. In our oppinion this problem shows poor design in the SSL, because allows this too happen. It would be better to correct this flaw in the law than to increase the annuities price arbitrarily.

4.1 Regulation of Insurance Firms

Insurance firms compete on the basis of promised benefits. Given the MCs or the accumulated balance in workers' individual accounts and expected survivorship, firms are competing on the basis of the real interest rates guarantee to their clients.

An insurance carrier may not be able to meet its obligations if pensioners live longer than expected and/or are not able to obtain in financial markets returns on investments at least as large as those compromised.

Regulation of insurance firms must guarantee their solvency at the lower cost for clients and the Government. Excessive regulation may lead to higher prices than required for the services provided, reducing workers' welfare. Inefficient regulation may also lead to higher prices and worse of all may not prevent a carrier's insolvency.

It should be mentioned that for the annuity market derived from the SSL there are not explicit Government guarantees to workers if an insurance firm becomes insolvent.

However, given that workers or beneficiaries are obliged to buy annuities if they die or become disabled, and given that insurance firms are authorized and supervised by the government, it is likely that pensioners believe that the Government will stand for them if the provider cannot.

Given the social nature of this market, we strongly believe that workers' presumption is right. Because of this, a bad design in the regulation of insurance firms is likely to increase Government's fiscal costs.

Regulation must not only consider the adequate constitution of technical reserves and excess capital but also the adequate risk management of assets and liabilities. Capital requirements must be set if the carrier is not managing (or cannot manage) assets and liabilities properly.

With respect to technical reserves, we consider that the design of the Special Mathematical Reserve, Prevision Reserve and the Reserve for Changes in Assets' Value must be changed.

Currently, the Special Mathematical Reserve is constituted at most with 5% of the difference between expected and observed losses and should be constituted with the full difference. This would be consistent with the established loads to survivorship probabilities. By doing so, this reserve could replace the current Prevision Reserve.

The Prevision Reserve is equal to 2% of the Mathematical Reserve instead of to 2% of the MC. However, it would be better to eliminate the 2% load to the MC, which as mentioned before is too high and has no technical support.

The constitution of the Reserve for Changes in Assets' Value is arbitrary and is not related to the cash match of assets and liabilities at the real rates of return established in the contracts.

The problem is that the current regulation of investments does not measure the risks that an insurer is incurring according to the compromise liabilities and its investment strategies. Instead, it imposes arbitrary liquidity constraints to the assets in which reserves can be invested and restricts portfolio choice by imposing quantitative restrictions.

A well known result in portfolio theory is that regulations based on quantitative restrictions by limiting portfolio choice do not permit fund managers to diversify risks efficiently. As a result of this, managers are forced to bear more risk for the same expected return or to expect less return for the same risk level.

It would be better to base investment guidelines on the prudent investor rule that does not restrict investments on asset classes and do not impose quantitative restrictions, rather it seeks appropriate risk management through an appropriate diversification of risks taking into consideration the funds objectives.

Asset-liability management must be required as well. For annuity providers this means that carriers must follow investments strategies that guarantee that expected cash flows from investments are at least as large than the expected cash flow payments to pensioners. For this reason, carriers must follow dedicated portfolio strategies, immunization strategies (such as duration matching of assets and liabilities) or portfolio insurance, among others.

Capital requirements must be set at the firm level depending on the assumed liabilities and investment strategies. The regulatory authority should require more excess capital for those carriers facing more risk. In the theoretical extreme of a perfect cash match, excess capital should be set equal to zero.

As mentioned before, investment guidelines obliged firms to invest in securities indexed to the CPI and do not allow carriers to invest in foreign securities. These restrictions together with the current supply of securities in Mexico's financial markets makes cash-match strategies impossible.

Nevertheless, in the annuity market some carriers are adopting more risky strategies than others and this has not been disclosed to clients, and even though carriers must constitute reserves for additional benefits its adequacy has not been determined since risk has not been properly measured.

4.2 Potential Moral Hazard Problem

In our opinion there is also a potential moral hazard problem in the annuity market which has been neglected. The problem may arise due to the fact that workers choose provider on the basis of benefits (real returns guaranteed) without taking into consideration risk and also because shareholders face a limited liability.

In order to sell more annuities, firms must lower price i.e., offered more benefits and without perfect cash-match, this increases the probability of insolvency. Since shareholders have a limited liability equal to the capital requirements, if unable to meet compromises, the difference is very likely to be paid by the

Government. In other words, firms' shareholders are given a put option by the Government.

To illustrate the problem, let L stand for the liabilities compromised by an insurance carrier at a point in time. Let A_{TR} be the value of the assets in which technical reserves are invested, and A_C the value of the capital required by the regulatory authority. Then the payoff functions for shareholders, V_S , and the Government, V_G , are equal to the following:

$$V_S = \begin{cases} A_{TR} - L & \text{if } A_{TR} \geq L - A_C; \\ -A_C & \text{if } A_{TR} < L - A_C. \end{cases} \quad (10)$$

$$V_G = \begin{cases} 0 & \text{if } A_{TR} \geq L - A_C; \\ A_{TR} + A_C - L & \text{if } A_{TR} < L - A_C. \end{cases} \quad (11)$$

The payoff functions are also shown in figures 4.1 and 4.2. The exercise price is equal to $L - A_C$. If the value of the assets in which technical reserves are invested is lower than the exercise price, the insurance firm will exercise the option and will sell the firm to the government. The Government will have to pay the difference between the value of all assets and the liabilities compromised by the insurance firm.

Figure 4.1
The Payoff for Shareholders

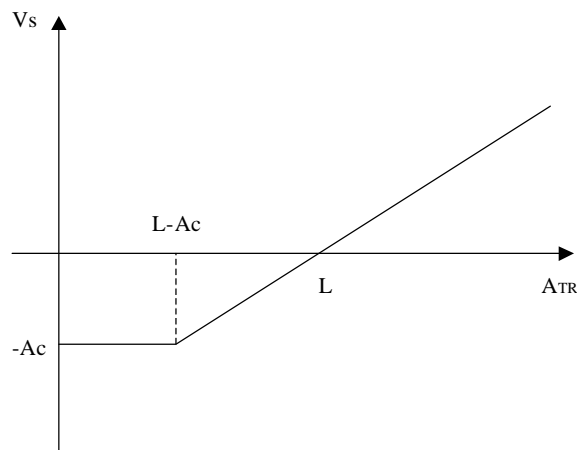
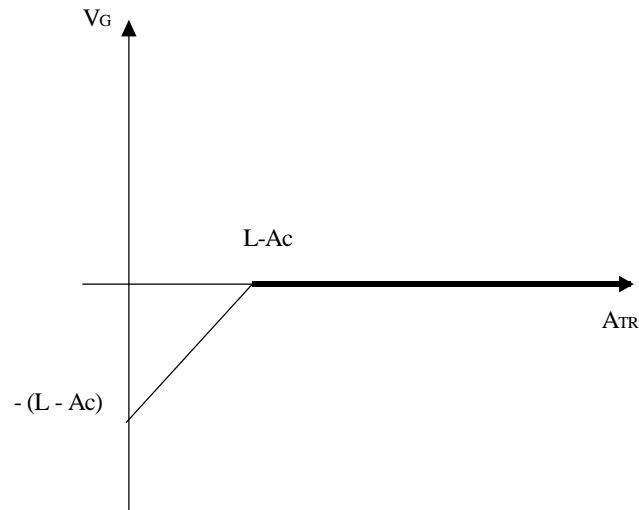


Figure 4.2
The Payoff Function for Government



As is well known from option pricing theory, the value of a put option is an increasing function of the exercise price, the underlying asset volatility and the time to exercise date. The value of the put option is also a decreasing function of the value of the underlying asset and the risk free interest rate.

In the case of the annuity market the time to date is not determine, i.e., firms are given an american option that does not expire over time. This makes the option more valuable to insurance firms.

The underlying asset is the value of the assets in which technical reserves are invested, A_{TR} . Everything else the same the value of the underlying asset is higher the higher are the reserve requirements set by the the regulatory agency. Therefore, the higher are the reserve requirements, the lower will the value of the option to firms' shareholders.

The volatility of the underlying asset depends on the investment strategies followed by the insurance firm. If the investment portfolio is perfectly inmunized,

for example by investing in zero coupon bonds with a yield greater than or equal to the guarantee real interest rate to workers and with the same maturity as liabilities, the volatility of the underlying asset with respect to compromised liabilities is equal to zero and so would be the value of the put option.

The value of the exercise price depends negatively on the value of required capital and positively on expected liabilities. The cost of the option to firms is at most equal to the required paid in capital, since this capital is partially or totally used if $A_{TR} < L$. The value of required capital is determined by the regulatory authority and is generally lower than the value of expected liabilities. The higher the required capital the lower will be the value of the option to firms.

Expected liabilities is a choice variable of an insurance carrier. As mentioned before firms compete by offering workers at retirement guaranteed real rates of return for their accumulated assets. The higher the real rate of return guaranteed the higher will be the expected liabilities for two reasons: more policies will be sold and for every policy the firm is committed to pay higher benefits to pensioners.

Therefore, insurance firms increase the value of the option by increasing expected liabilities. Besides, presumably the higher the guaranteed real rates of return the riskier will be the investment strategies. This will further increase the value of the option.

It would be advisable to the Government to value the options that is providing to insurance carriers and to be aware of the possible fiscal contingencies that may face if an insurance provider becomes insolvent. It must also be aware that this risk may become systemic: if an insurance firm offers high real rates of return to gain market share it is likely that the best response of competitors would be to follow the bids.

Regulations can be put in place to mitigate the problem. For instance, capital requirements could be determined per firm depending on compromised liabilities and investment strategies.

In addition, market discipline should be put in place by requiring firms to disclose all relevant information to all market participants. For example, carriers could be required to be rated by independent rating agencies and to disclose their credit risk.

Besides, it is important to let workers know in a simple fashion that insurance firms face limited liabilities and that the Government will not protect them if a provider becomes insolvent. However, since this threat may not be credible, alternatively, the Government could compromise explicitly to protect workers but only to certain extent, perhaps to guarantee pensions at most equal to the MPG.

5. Conclusions

In this note a description of the functioning of life and disability insurance, workers' compensation insurance and the annuity market for the pension system for private sector employees was presented.

It was shown that the current design of life and disability insurance is not adequate: premiums were established in the SSL before the CMC was created, and since this committee is responsible of determining the actuarial assumptions for the MCs, premiums do not consider the compromised obligations of IMSS. Besides, premiums do not consider the accumulated balance in the individual accounts.

It was also shown that under reasonable assumptions premiums for life and disability insurance are insufficient and higher than the ones observed in other countries in Latin America with similar pension schemes, and several reasons to explain why this might be the case were mentioned.

With respect to workers' compensation insurance the current model does not consider fringe benefits and the risk premium was arbitrarily overloaded. The net effect on the premium seems to be, according to a study by Gonzalez (2000), that it is higher than it should be.

An evaluation of the current regulation in the annuity market was also provided. The main conclusion is that a thorough revision of the required technical reserves and excess capital requirements is necessary.

The Special mathematical Reserve could replace the current Prevision Reserve by forcing carriers to accumulate the maximum of the difference between expected and observed losses and zero, and by eliminating the arbitrary Prevision Reserve equal to 2% of the Mathematical Reserve.

The Reserve for Changes in Assets' value should be eliminated and instead of it, capital requirements should be put in place taking into consideration the compromised liabilities and the investment strategies of insurance firms.

Investment guidelines based on quantitative restrictions on investments should be replaced by risk management requirements to match assets and liabilities.

It was also mentioned that there seems to be a potential moral hazard problem in the annuity market due to workers' presumption that the Government guarantees the compromised benefits by insurance firms and because there is a limited liability for insurance firms' shareholders. For this reason, market discipline should be enhanced and perhaps additional regulations must be put in place.

References

Blake, David, *Financial System Requirements for Successful Pension Reform*, presented at pension System in Asia, Manila, diciembre 1998, mimeografiado.

CIDE , *Análisis de los Seguros de Invalidez y Vida y Riesgos de Trabajo en la Nueva Ley del Seguro Social*, 2000b

González Baez, Alejandro, *Suficiencia Financiera del Seguro de Riesgos de Trabajo bajo al Nueva Ley del IMSS*, en *Visión Actuarial*, Asociación Mexicana de Actuarios Consultores, abril 2000.

IMSS, *Ley del Seguro Social*. 1995.

Consar, *Ley de los Sistemas de Ahorro para el Retiro*, 1996.

CNSF, *Ley de Instituciones y Sociedades Mutualistas de Seguros*, 1997.

CNSF, *Seguros de Pensiones derivados de las Leyes de Seguridad Social*, 1997.

Queisser, Monika, *The Second Generation Pension Reforms in Latin America*, Development Centre Studies OECD, 1998.

Sales-Sarrapy, Carlos, F. Solís-Soberón and A. Villagómez (1999), "Pension System Reform: The Mexican Case", en Feldstein, Martin (ed), *Privatizing Social Security*, The University of Chicago Press.

Solís Soberón Fernando, *Descripción del Sistema de Ahorro para el Retiro*, Documento de Trabajo, CONSAR, septiembre 1994.

_____, *Alternative Regulatory Approaches: The Choice of Regulator of Pension Funds*, 1998, mimeografiado

_____, *The Regulation of Investments in Latin American Defined Contribution Pension Schemes*, en *Institutional Investor in Latin America*, OECD, 2000.

_____, *Los Sistemas de Pensiones en México, La Agenda Pendiente*, 2000, mimeografiado.

Solís Soberón Fernando y A. Villagómez, *La Seguridad Social en México*, Fondo de Cultura Económica, 1999.